



# CN / CXT Sustainability Assessment



## Project Scope:

This project involved information collection and development of recommendations for the sustainable production of concrete ties. Research spanned sustainability, CXT company practices and supply chain, concrete tie production techniques, life cycle analyses, tie disposal through recycling and reuse, and process modeling. The main objectives of the project were to:

- Create a model that tracks the sustainability of CXT Concrete Ties
- Identify applicable and practical performance metrics that can serve as benchmarks
- Calculate the carbon footprint for Spokane, WA CXT production facility
- Compare the sustainability of concrete and wood ties
- Define what sustainability should be for CXT

## Definition of Sustainability:

Sustainability is meeting current economic needs while promoting social qualities and environmental practice as much as possible from the extraction of materials before production to when the product is discarded after final use. For CXT this means the efficient allocation of material resources to create a quality product, while providing a safe workplace for employees and having an active presence in the community.



**LB Foster**  
CXT Concrete Ties

### Social Sustainability Model

**Key**

- Input the number
- Input the monetary amount
- Input the percentage (10% would be entered as 10, not 0.1)
- Input yes or no specifically
- Input value directly from the Employee Opinion Survey

**Company Demographics**

- Total number of employees
- Number of employees that are African American, Asian, Native American, or Latino
- Number of female employees
- Average number of hours worked per week
- Number of full-time employees who make less than \$22,500/year
- Number of employees hired within the last year
- Number of employees that lost their jobs within the last year

**Amounts Given**

- Donations given within the last fiscal year
- Scholarships given within the last fiscal year
- Amount given to Charities within the last fiscal year
- Value of food and/or essentials given to charity within the last fiscal year
- Price of non-product related spending aimed at employee happiness within the last fiscal year
- Yearly cost of maintaining recreation facilities
- Number of hours that employees spent working on volunteer projects
- Average health care coverage for each employee per year (health insurance, dental, etc.) % matching for 401k
- Average wage increase for among all non-management positions within the last year
- Company's DART safety rating
- If DART safety rating is unknown, input number of Days Away, Restricted, or Transferred that employees had due to injuries during the last year here)

**Employee Opinion Survey**

- 3. I would like to be working at this organization one year from today
- 50. This organization is effective in welcoming new employees and helping them begin a new job
- 9. The organization makes investments to make me more successful
- 33. The leaders of this organization are committed to making it a great place to work
- 47. At work, my opinions seem to count
- 2. I enjoy doing my work
- 36. My benefits meet my (and my family's) needs well.
- 41. Our organization is involved with the community in which it does business

**Other**

- Have you been accredited by a 3rd party company on sustainable or social responsibility? If no, have you been attempting to get accredited by a third party?
- Is there a company statement regarding fair labor practices and ethics publicly available?

Score: ###

### Production Facility Model

Material	Quantity	Units	Unit Price	Total Cost	CO2 Produced (Tons/year)
Tie Ingredients					
Cement (Type III)	30,000	tons	\$ 12.00	\$ 360,000	2,509
Coarse Sand	75,000	tons	\$ 12.25	\$ 918,750	899
Fine Sand	5,000	tons	\$ 15.75	\$ 78,750	77
Pea Gravel	50,000	tons	\$ 14.25	\$ 712,500	697
3/4" Gravel	70,000	tons	\$ 14.75	\$ 1,032,500	1,030
Admixtures					
Retardant	123	gallons	\$ 123.00	\$ 15,129	22
Air Entrainment	123	gallons	\$ 123.00	\$ 15,129	22
Water Reducer	123	gallons	\$ 123.00	\$ 15,129	22
Steel					
Stressing wire	123	tons	\$ 123.00	\$ 15,129	34
Plastic & PVC					
Date plugs	123	tons	\$ 123.00	\$ 15,129	8
Form pockets	63,000	each	\$ 123.00	\$ 7,749,000	3,946
Other Items used					
Steel casting forms	123	tons	\$ 123.00	\$ 15,129	34
Abrasive Cutting Wheels	650	each	\$ 123.00	\$ 79,950	35
Form release oil	123	gallons	\$ 123.00	\$ 15,129	2
Circulating oil	123	gallons	\$ 123.00	\$ 15,129	2
Utilities & Fuel					
Electricity	1,234	kW	\$ 123.00	\$ 151,782	1,037
Natural gas	1,234	gallons	\$ 123.00	\$ 151,782	2
Water	1,234	gallons	\$ 123.00	\$ 151,782	124
Diesel Fuel	1,234	gallons	\$ 3.50	\$ 4,319	14
Biodiesel	1,234	gallons	\$ 4.00	\$ 4,936	7
Regular gasoline	1,234	gallons	\$ 3.50	\$ 4,319	14

**Recycling Metrics**

Item/material recycled	Quantity	Price	Income	Tons CO2 Saved
Rejected ties	500	\$ 15.00	\$ 7,500	5.83
Scrap concrete (tons)	10	\$ 5.00	\$ 50	0.05
Scrap stressing wire (tons)	10	\$ 3.00	\$ 30	0.06
<b>Total:</b>			<b>\$ 7,600</b>	<b>5.93</b>

**Landfill Metrics**

Item	Quantity	Price	Income	Tons CO2 Saved
Tons of Material Landfilled per Year	5,000			
Number of Trips to Landfill per Year	500			
Gas Mileage of Truck Full	6			
Gas Mileage of Truck Empty	8			
Average Diesel Fuel Price	\$ 3.50			
Miles to Landfill	1			
Landfill Fee (\$/ton)	\$ 103.00			
Gallons of diesel used	346			
Transportation Emissions (Tons CO2/year)	444			
<b>Total Cost (dollars)</b>			<b>\$ 515,510</b>	

**Inbound Material Transportation**

Item	Quantity	Price	Income	Tons CO2 Saved
Distance	1,000			
Tons of cargo	180			
Truck Emissions (Tons CO2)	16.00			
Rail Emissions (Tons CO2)	5.20			

**Outbound Tie Transportation**

Item	Quantity	Price	Income	Tons CO2 Saved
Distance	1,000			
Tons of cargo	180			
Truck Emissions (Tons CO2)	16.00			
Rail Emissions (Tons CO2)	5.20			

**Carbon Footprint: (Tons CO2/year)** 10,493

**Total Costs (dollars/year)** \$ 11,521,957

**Number of ties produced last year:** 900,000

**Emissions per tie: (lbs CO2/tie)** 23.317

**Emissions per dollar: (lbs CO2/dollar)** 1.82

Values entered are for demonstration purposes only, they do not portray CXT's actual results.

### Tie Disposal Model

**Production Emissions (Tons CO2):** 21,493

**Inputs:** Results (lbs CO2 Produced)

**General Inputs**

These values are used in multiple sections to calculate the cost of fuel used in transportation.

Item	Quantity	Price	Income	Tons CO2 Produced
Can Mileage of Truck, Empty	8			0.31
Can Mileage of Truck, Full	8			0.31
Average Diesel Fuel Price for the year	\$ 3.50			

**General Recycling**

Calculates the income and emissions applicable to all types of recycling.

Inputs	Quantity	Price	Income	Tons CO2 Produced
Number of Ties Recycled per Year	1,037,000			46,325
Weight of concrete (lbs per tie)	800.00			\$ 320,168
Weight of steel (lbs per tie)	12.50			1,085
Price of recycled concrete, 1.3' (\$/ton)	7.00			1,085
Price of recycled concrete, 1.3' minus (\$/ton)	7.00			1,085
Price of recycled concrete, 3.5' minus (\$/ton)	7.00			1,085
Average price of recycled concrete (\$/ton)	7.75			1,085
Price of recycled steel (\$/ton)	7.00			1,085

**Portable Recycling Machine**

Calculates the costs and emissions of owning a portable recycling machine that goes to the jobsite.

Inputs	Quantity	Price	Income	Tons CO2 Produced
Number of hours machine runs per year	400			44,880
Costs per hour of diesel used	\$ 11.15			44,880

**Stationary Recycling Machine**

Calculates the costs and emissions of owning a stationary recycling machine at a CXT or LBFaster facility.

Inputs	Quantity	Price	Income	Tons CO2 Produced
Number of Trips to Recycling Machine per year	100			37,400
Miles to Recycling Machine	100			28,050
Number of hours machine runs per year	400			44,880
Costs per hour of diesel used	\$ 11.15			44,880

**Contractor Recycling**

Calculates the costs and emissions of contracting out your recycling to another company.

Inputs	Quantity	Price	Income	Tons CO2 Produced
Number of Trips to Contracted Recycler per year	100			37,400
Miles to Recycling Contractor	100			28,050
Contractor Price per ton	\$ 1.00			28,050

**Landfill**

Calculates the costs of disposing the ties in a landfill.

Inputs	Quantity	Price	Income	Tons CO2 Produced
Number of Ties Landfilled per Year	1,037,000			21,493
Number of Trips to Landfill per year	500			451
Landfill Fee (\$/cubic yard)	\$ 1.00			33.1
Miles to Landfill	1			191,000

**Summary of all data above**

Category	Costs or Income	Tons CO2 Produced	Including
Original Method	\$ 11,521,957	10,493	23,317
Portable Recycling Machine	\$ 1,037,000	46,325	23,317
Stationary Recycling Machine	\$ 1,037,000	46,325	23,317
Contractor Recycling	\$ 1,037,000	46,325	23,317
Landfill Metrics	\$ 515,510	444	23,317

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**Transportation Enterprise**

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- <http://transportation.enterprise.mtu.edu>
- Contact: George Dewey at [gdewey@mtu.edu](mailto:gdewey@mtu.edu)

## Project Results:

Through research and numerous meetings with industry sponsors, CN and CXT, and university professors, we were able to define sustainability in respect to CXT's manufacturing processes and develop models to track CXT's sustainability over time. Our final deliverables were:

- Model that tracks CXT's production emissions based on fuel consumption, as well as energy and material usage
- Model that evaluates CXT's social sustainability based on employee satisfaction, demographics, and safety, as well as benefits provided to employees and the community
- Model to evaluate various tie disposal options, both by emissions and potential profit
- Literature review comparing lifetime CO<sub>2</sub> emissions of concrete and wood ties
- Definition of sustainability as applied to CXT

**Clients:**

- As the widest reaching railroad in North America, CN is committed to protecting the environment and ensuring the health and safety of their employees and the public.
- As the largest supplier of concrete ties in North America, CXT strives to produce a high performance, high value product that is also environmentally responsible.

